



The Future is Now: Autonomous Vehicles Have Arrived

Report on Secondary Research and Expert Interviews

UPDATED: February 2016

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INTERNATIONAL



Purpose of this report

This report shares findings from a review of secondary research and from interviews with experts on autonomous vehicles (AVs) conducted by SIR in August and September, 2016.



Mercedes-Benz Autonomous Vehicle Concept Car





conducting the study

Methodology

Interviewed experts within the Commonwealth

Interviewed national experts, reviewed their work

Reviewed available secondary research, articles, videos, and other materials on autonomous vehicles

Reviewed activities related to autonomous vehicles in other cities and countries, including Oslo, Dubai, Sweden, and Japan.

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methodology

List of experts

VIRGINIA

David Zuby, Insurance Institute for Highway Safety

Dean Gustafson, VDOT, State Operations Engineer

Cathy McGhee, Virginia Transportation Research Council, Associate Director

Greg Fitch, Ph.D., Virginia Tech Transportation Institute, Research Scientist

NATIONAL

Joanna Pinkerton, Ohio State University, Co-Director, Honda/OSU Partnership

Jade Nobles, Engineer, Toyota

Ian Grossman, American Association of Motor Vehicle Administrators (AAMVA), VP, Member Services & Public Affairs

Adam Jonas, Morgan Stanley, Managing Director and Leader of Global Auto Research Team

Raj Rajkumar, GM, Carnegie Mellon, Professor, Electrical and Computer Engineering and Cylab

John Leonard, MIT, Associate Department Head

Ryan Calo, University of Washington

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What's Happening in Virginia

There are many
things underway
already in Virginia
around auto-
mous vehicles

5



activities in Virginia

AVs are welcome in the Commonwealth

“Open Door” Policy

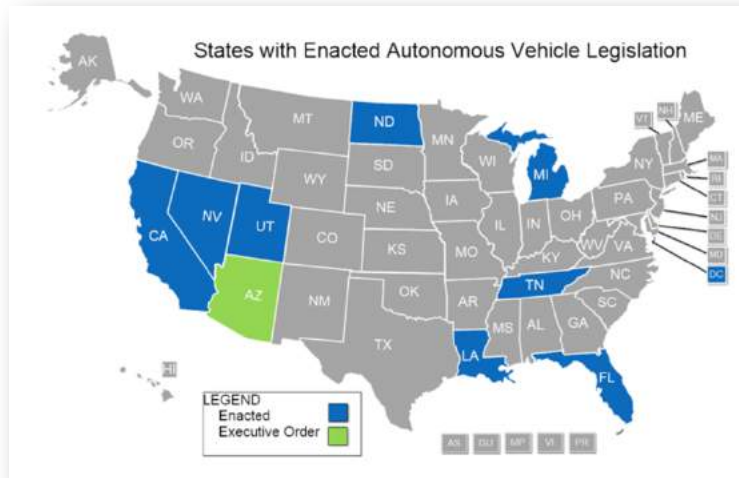


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activities in Virginia

“No Laws” seems to mean no interest in AVs



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activities in Virginia

“New Laws” appear to open doors to AVs

Posted January 28, 2017 - 10:59pm | Updated January 29, 2017 - 8:38am
Bill would pave way for driverless car fleets in Nevada



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activities in Virginia

The state has a comprehensive story on AVs

- Virginia Tech Transportation Institute – recognized globally
- Home of cyber security – a key issue related to AVs
- State-of-the-art pavement marking capabilities, for connected and autonomous vehicle testing
- Several significant corridors open and ready for testing
- A multi-agency review and approval process already in place
- Leading the Connected Vehicle Pooled Fund, the AASHTO initiative
- Commitment from the governor and active participation from the Secretary of Transportation's office

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IMPLICATION for What's Happening in Virginia

Virginia needs to **more effectively communicate its story** of being “open for business” when it comes to AVs.

Many initiatives are underway and the Commonwealth has a range of assets and activities it can talk about to attract organizations developing the future of AVs.

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Key Findings & Implications

What's happening around the U.S. and world, and when will autonomous vehicles become commonplace?

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“The challenge is that we don’t know *exactly* what’s coming, **but we know it’s coming. We all have to learn to change on a dime.”**

**Councilwoman Pam O’Connor
Santa Monica, CA**

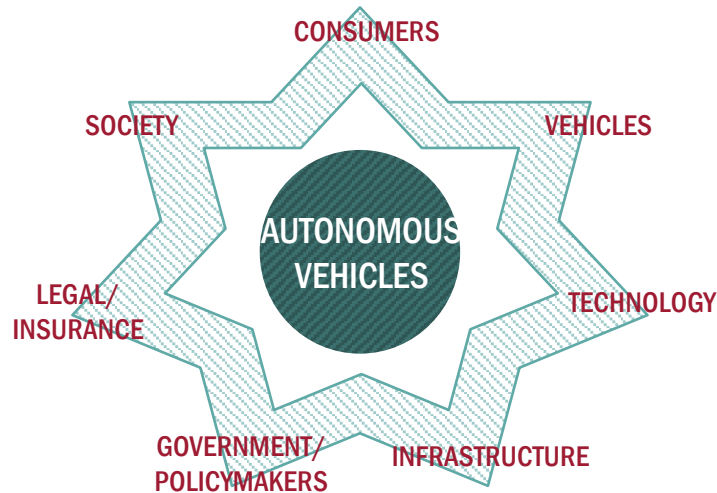
From “City of the Future,” National League of Cities, 2015

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the AV ecosystem

Multiple connected components need to line up to make AVs a reality



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the AV ecosystem

There are many issues to be resolved

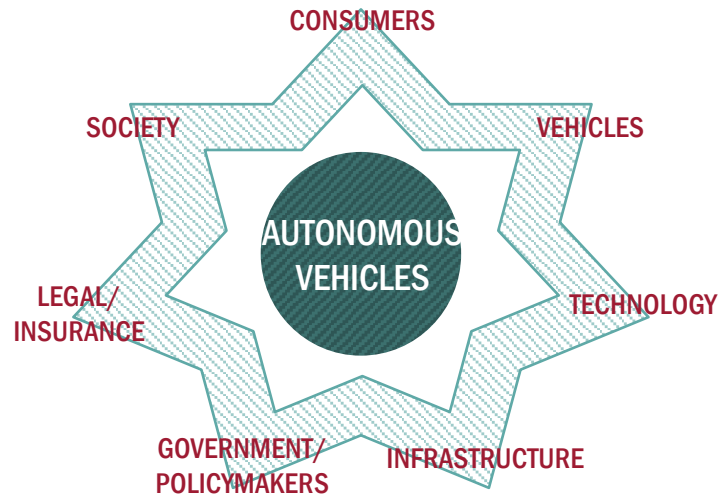
COMPONENT	POTENTIAL ISSUES
CONSUMERS	Will they give up traditional cars to share a ride? How will they behave during the transition period when autonomous vehicles start appearing?
VEHICLES	Traditional car makers (called Original Equipment Manufacturers or OEMs) and new players like Uber and Google are scrambling to build AVs. Who is ahead?
TECHNOLOGY	Will it work? Can it be hacked? Can it survive glitches or fatal errors? Will we have the bandwidth necessary for high-end CV?
INFRASTRUCTURE	What's required to make AVs work? Who funds what? What happens to transit?
GOVT & POLICY	What role will regulations play? What limits are needed and when?
LEGAL/INSURANCE	Who is liable in accidents? Who pays what for coverage?
SOCIETY	What industries are impacted by AVs? What happens to displaced workers like truck drivers, car mechanics in a fleet-owned autonomous world?

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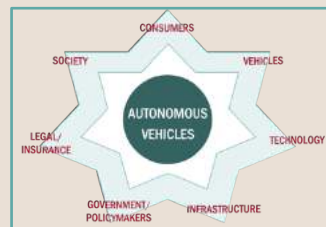


the AV ecosystem

Our findings focus on each component



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Consumers

Will they give up traditional cars to share a ride? How will they behave during the transition period when autonomous vehicles start appearing?

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key findings – consumers

1. Consumers are interested, but ...



BCG: Self-Driving Vehicles, Robo-Taxis, and the Urban Mobility Revolution, September 2016

Global survey among 5,500 consumers in 27 cities in ten countries:

Overall, 58% of respondents said they would take a ride in an autonomous vehicle, and 69% said that they would take a ride in a partially self-driving car.

Willingness is highest among younger consumers—63% of those aged 29 or younger are willing to ride in an AV compared with 46% of consumers aged 51 or older.

https://www.washingtonpost.com/local/trafficandcommuting/are-you-ready-to-try-a-driverless-car-70-percent-of-americans-say-yes/2016/10/06/c0abb25e-8b3c-11e6-875e-2c1bfe943b66_story.html

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key findings – consumers

2. They are not sure what AVs are all about



A survey from Kelly Blue Book reported in the WSJ found that consumers are interested in the idea of a car that can drive itself, but they are not sure what that means exactly.

Part of the issue is what we call it.

Just like "motor car" wasn't the first term for the horseless carriage built by Karl Benz, the final consumer accepted name for driverless cars, self-driving cars, or autonomous vehicles is not yet known.

<http://www.wsj.com/articles/autonomous-what-americans-arent-sure-what-self-driving-cars-are-all-about-1475056802>

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key findings – consumers

3. Older Boomers, Millennials and the next generation, Gen Z's, will quickly embrace AVs

BOOMERS

Every day another 10,000 Boomers reach age 65. By 2030 one in four cars on the road could have someone over 65 behind the wheel. Providing safe and reliable mobility for older Boomers will make AVs very attractive to the Boomer generation.

MILLENNIALS

The “sharing economy” is a Millennial invention, and sharing rides in driverless Ubers will seem like a natural next step for this generation. Plus, they will be eager to catch a ride since AVs will be lighter, all electric, and green in design and locomotion.

GEN Z

Coming of age now, in a world where danger seemingly lurks around the next corner, this generation is very security and safety minded. Knowing AVs can prevent some 30,000 deaths from car accidents annually is enough to motivate them to get on board.

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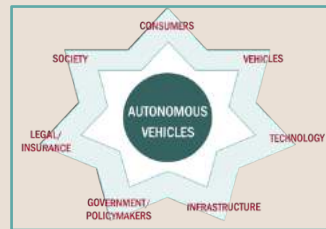


IMPLICATION for Consumers

Some marketplace transformations happen because consumers lead them, pulling industry and policymakers along. In the case of AVs, in these early days, consumers will be followers, adopting new mobility options once they are readily available.

Supply will create the demand.

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Vehicles

OEMs and new players like Uber and Google are scrambling to build AVs. Who is ahead? Are there competing approaches?

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key findings – vehicles

1. Autonomous vehicles are here

Innovation in autonomous vehicles is happening everywhere it can.

The “tipping point” was the summer of 2016. As of October, **some 19 companies have announced plans** for AVs to be available within three to five years.

It was 2009 when Google first announced an initiative to develop driverless cars. Since then their driverless cars have already covered two million miles, and every day their simulators drive three million more.

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key findings – vehicles

2. Summer 2016 was the tipping point

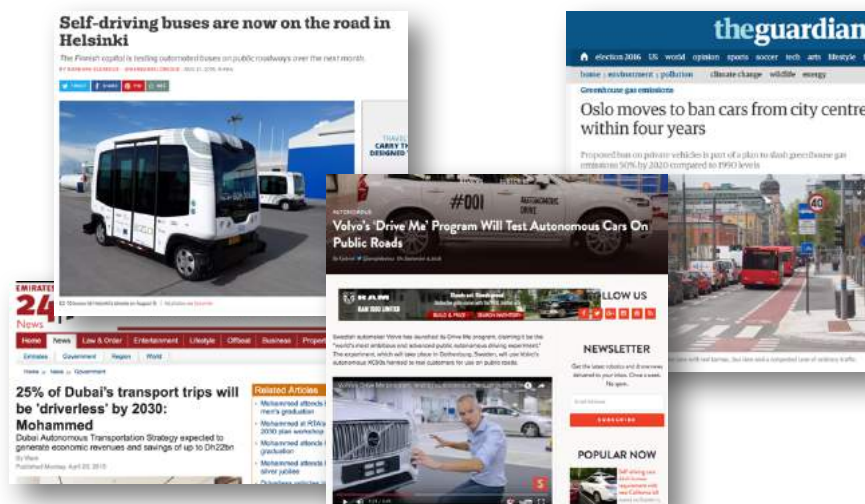
MAY	BMW announces iNext, an electric driverless car by 2021.
JUNE	Local Motors announces Olli, electric driverless mini-bus with IBM Watson technology.
JULY	GM announces investment of \$500 million in Lyft, with plans to build autonomous fleet by 2020. Uber buys Otto, a start-up developing autonomous 18-wheelers.
AUGUST	Ford announces Level 4 autonomous vehicles by 2021. Delphi and MobilEye announce technology to make a variety of cars driverless available by 2019. NuTonomy starts testing driverless taxis in Singapore, with plans for fleet by 2018, and in 10 cities by 2020.
SEPTEMBER	Softbank announces test of autonomous buses in Japan. Uber begins live testing of driverless taxis in Pittsburgh.

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key findings – vehicles

3. AVs are happening around the world



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“The pace at which autonomous cars are coming on is dramatically faster than what people had imagined.”

Robin Chase, former CEO of car sharing company Zipcar

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key findings – vehicles

4. The players in AVs are different

OEMs	BMW, Ford, GM, Volvo, Honda, Toyota, Mercedes, etc.
TECHIES	Google, IBM, nVidia
TNCs	Uber, Lyft, Bridj
START-UPS	Local Motors, EasyMile, Otto, Optimus Ride (MIT), nuTonomy

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key findings – vehicles

5. There are different approaches underway

Most OEMs are designing incremental autonomy into vehicles while Google and other start-ups are launching Level 5, fully automated, vehicles.

Already, autonomous vehicle “dance” partners are pairing up. We expect to see public/private partnerships in the next few years as experimenting with the impact of AVs on a community will drive innovation.

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key findings – vehicles

6. Vehicles themselves will change dramatically



Google's Self-Driving Car



Olli from Local Motors

“Why have a 4,000-pound automobile that seats five to move one person a short distance at low speed?”

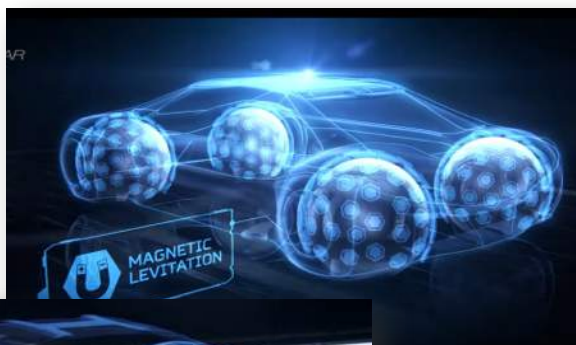
-- Kent Larson, MIT

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key findings – vehicles

7. Ancillary auto suppliers are thinking AVs, too



<https://youtu.be/RHpxuwcNjfo>

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key findings – vehicles

8. The consensus on timing is “now”

From our interviews with experts and a comprehensive review of articles and reports, the consensus view on the timing of AVs is:

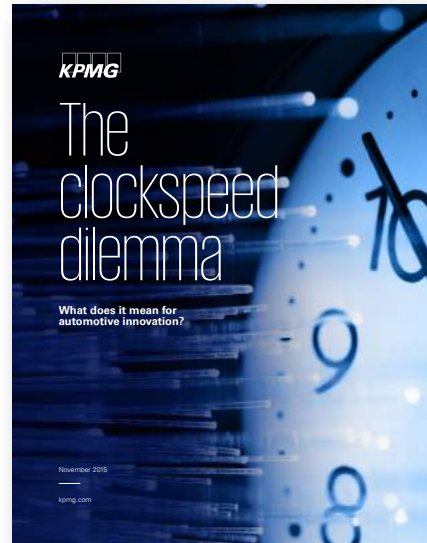
Now-2018	Test and pilot programs of “robo-taxis” in larger cities. Fleets operational starting in 2018 in certain sections of larger metro areas.
2020	Full AVs available for consumer purchase, although where they are allowed to operate fully automatically may be limited.
2025	Fleets of AVs readily available in most metro areas. Consumers will still own their own cars, but most will prefer AVs. Affordable retro-fitting will be available for existing vehicles.
2030	Enough AVs operational to impact society and how and where we live.

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key findings – vehicles

9. The development speed is problematic



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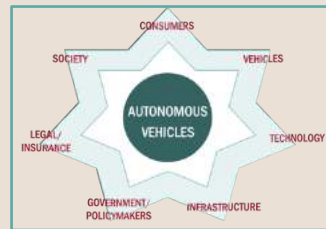


IMPLICATION for Vehicles

Multiple approaches by multiple players, many of whom are partnering together, means state and local governments should **seek opportunities now to begin forming relationships.**

It's not clear who or what will “win” when it comes to AVs, so the smart strategy is to **partner with as many players** as feasible.

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Technology

Will it work? Can it be hacked? Can it survive glitches, or fatal errors? Will we have the bandwidth necessary for high-end CV?

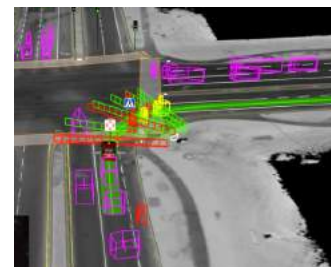
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key findings – technology

1. Infallible technology is the starting point

Acceptance of AVs hinges on the cars and trucks behaving exactly as desired.



Google uses LIDAR, sophisticated positioning GPS, and accumulated “learning” from over 2 million miles on the road.

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key findings – technology

2. The tech isn't ideal yet

PEOPLE DO BETTER	AVS DO BETTER
If a construction worker uses hand gestures to tell a car to either go or to stop, no autonomous car today can reliably make the right decision.	We can build them to have no blind spots, to maintain full 360-degree awareness.
When the sun is immediately behind a traffic light, most cameras won't be able to recognize the color of the signal through the glare.	They will never drive drunk or be distracted while driving. They don't get tired, and need breaks only for maintenance.
If we see a truck with a "Makes Wide Turns" sign, we know how to adjust our driving accordingly.	They have much faster reaction time than humans.
If we see children distracted by the ice cream truck across the street, we know to slow down, as they may dash toward it.	They won't speed, tailgate, drive aggressively, brake late or exhibit other "bad driving" habits.

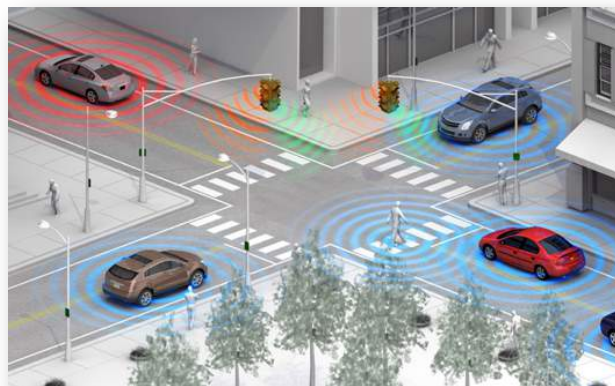
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key findings – technology

3. The future isn't AVs vs. CVs, it's both

Developers focused on Connected Vehicles realize that drivers will not be a key component of the vehicle soon.



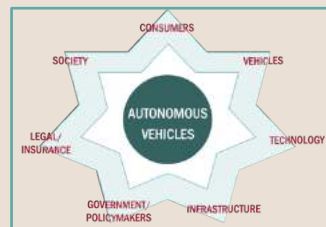
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IMPLICATION for Technology

There is no need to support one AV technological approach over another. The ultimate operating system will be a combination of several technologies. At this time, the best course of action is to **monitor progress and support several** leading candidates.

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Infrastructure

What's required in order to make AVs work? Who funds what? What happens to transit systems?

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key findings – required infrastructure changes

1. AVs will transform road infrastructure

PHYSICAL & DESIGN CHANGES	TECH & SUPPORT CHANGES
The goal of optimizing road use for flow, volume, and safety during peak times will be less of an issue.	Roads will need to be smarter and connected to vehicles.
Initially, special sections of urban areas (downtown) or lanes will need to be provided for use by AVs only.	AVs will need to know when signals will change and where congestion is, requiring real-time traffic data to be readily available.
AVs should result in fewer vehicles on the road, but more miles traveled as they will be in constant use. This could cause wear on roads.	Traffic signals and other road signs will need to broadcast data.
Ultimately, highway design, traffic flow, parking lots and structures will all have to be modified due to AVs.	Road markings will need to be maintained and kept up-to-date in top condition, possibly even with embedded RF chips.

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key findings – required infrastructure changes

2. AVs will change how we live in urban areas



<http://bit.ly/2dhixXv>

“If we allow the introduction of automated vehicles to be guided by existing regulations we’ll end up with more congestion, millions of unemployed drivers, and a huge deficit in how we fund our transportation infrastructure.”

“Most people in charge of shaping cities — mayors, transportation planners, developers, and lawmakers — haven’t realized what is about to hit them and the speed at which it is coming. They continue to build as if the future is like the present.”

— Robin Chase, co-founder, ZIPcar

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key findings – required infrastructure changes

3. Parking will change first

Future of Cities



<https://youtu.be/DeUE4kHRpEk>

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key findings – required infrastructure changes

4. Ultimately, the transformation will be complete

DRIVE SWEDEN



<https://youtu.be/WmYsWYDQxul>

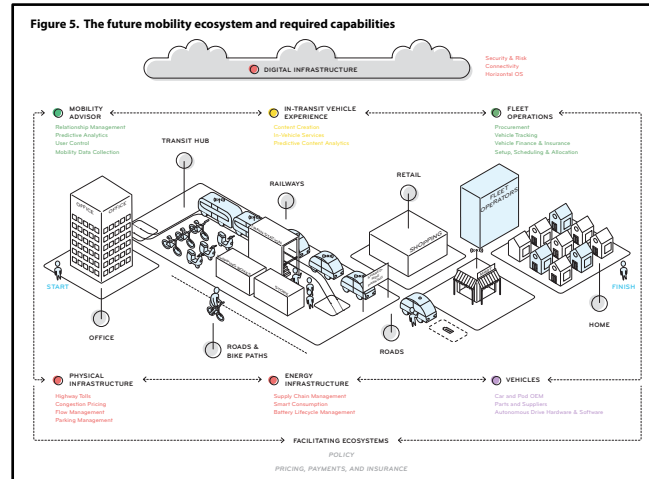
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key findings – required infrastructure changes

5. A view of the enabling infrastructure

From Deloitte



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key findings – required infrastructure changes

6. Impacts on transit infrastructure:

In Altamonte Springs, Florida, the local government has contracted with Uber to provide subsidized rides for citizens.



Debate and discussion about the impact of Uber, Lyft, and Bridj on transit and transportation systems will evolve into conversations about driverless versions.

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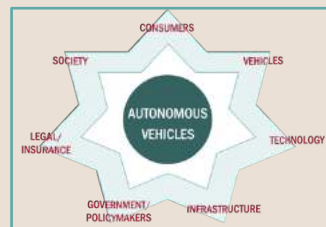


IMPLICATIONS for Infrastructure

Near term, those involved in road and community infrastructure should reach out to AV companies and attempt to **determine basic requirements** that facilitate implementation.

While the ultimate implementation of AVs won't be determined for a decade or more, **planning for that future should be top priority** for transportation professionals.

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Government/ Policymakers

What role will regulations play?
What limits are needed and when?

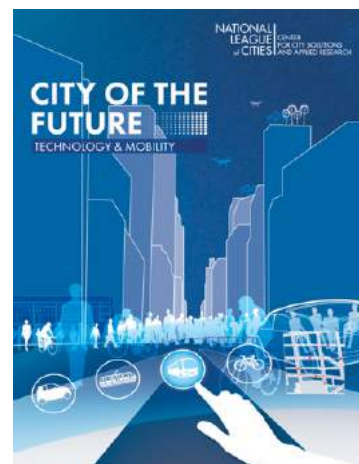
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key findings – government and policymakers

1. Virginia needs to react and plan now

The speed of adaption and the rate of change for AVs during these early days is remarkable. Community and transportation professionals will need to catch up quickly or will be left behind.



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Uber, Lyft and Transit

Emerging Partnerships:

TYPES OF RELATIONSHIPS:

- **Tier 1 partnerships** involve actually monetary investments or subsidizing of rides with offers that aren't available to the general public.
- **Tier 2 partnerships** are a concerted effort that yields some type of integration (API or otherwise) and/or a custom discount code (but the discount is the same as the public facing offer).
- **Tier 3 partnerships** are proposals that haven't been finalized or potential partnerships that are in the works or still being discussed.

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Partnership	Tier	Summary
PSTA & Uber Free/Discounted Ride Program	1	Free rides and transportation for economically disadvantaged riders and discounted rides within certain geographic areas
MTS San Diego & Uber	1	\$5 discount for UberPool rides to/from MTS transit centers during Comic-Con and MLB All Star Game
SEPTA & Uber Transit Partnership	1	40% discount on Uber rides to/from suburban rail stations
Altamonte Springs & Uber	1	Discount on rides within Altamonte Springs and to/from commuter train station
MBTA & Uber/Lyft	1	Subsidized rides for disabled passengers. Passenger pays first \$2 with MBTA covering next \$13.
Centennial & Lyft	1	Fully subsidized Lyft Line rides to/from the city's light rail station during commuting hours
MARTA & Uber ("Last Mile Campaign")	2	Insert Code: MARTAGuide and receive \$20 off your first ride
DART & Uber	2	Uber available through DART's mobile app
Lyft, Xerox and the City of LA	2	Integrated mobility app that combines public transportation and Lyft routing options
Washington DC Emergency Services & Uber	3	Proposal (to use Uber to transport non-critical 911 callers)
LAVTA & Uber/Lyft/Taxis	3	Replace bus service with wheels on demand to get people to Dublin BART station
Arlington County & Uber/Lyft	3	Proposal to use rideshare to replace low use (15 pax/hour) bus routes and connect riders with transit centers

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key findings – government and policymakers

2. Other states/localities are piloting AVs

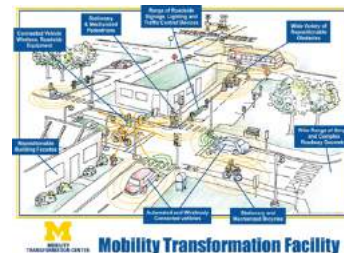
Uber, partnered with Ford and Volvo, is testing driverless cars in Pittsburgh.

Google is testing in Mountain View, CA, Austin, TX, Kirkland, WA and Metro Phoenix, AZ.

Olli, Local Motors' driverless 12-passenger mini bus, is about to test at the National Harbor area in Washington, DC.



"M City" has opened in Michigan. It's a 23-acre mini city at the University of Michigan, and is supported by the UM Transportation Research Institute, the Michigan Department of Transportation, and automakers Ford, General Motors, and Toyota.



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key findings – government and policymakers

3. Globally, others are issuing clarion calls

World's First Self-Driving Taxis Hit the Road in Singapore

Singapore's nuTonomy debuts autonomous cabs, beating the likes of U.S. tech giants Uber and Google



Singapore on Thursday became the first country in the world where self-driving cars serve as taxis, in a test of the technology by nuTonomy. Photo: Jake Maxwell Watts

Dubai launches self-driving transport strategy

Mohammad launches Dubai's self-driving transport strategy

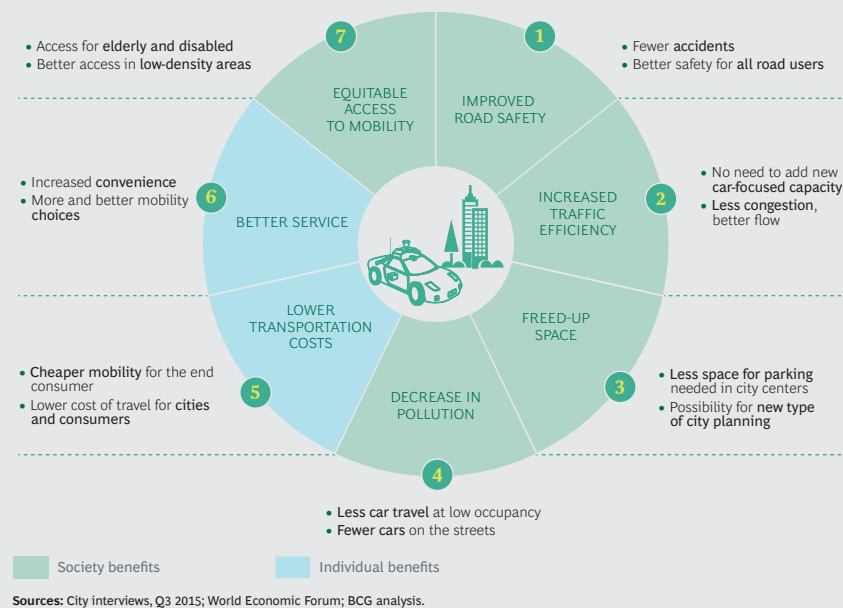


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key findings – government and policymakers

4. Policymakers see the benefits of AVs

EXHIBIT 9 | Policymakers See Widespread SDV Benefits for Both Individuals and Society



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key findings – government and policymakers

5. The intersection of revolution and regulation

BGC reports that policymakers have these concerns about AVs:

Impact on public transportation

Yes, AVs could solve last mile problem.

But, they could replace existing public transportation that needs to stay in service (and generate revenue).

Could create more urban sprawl

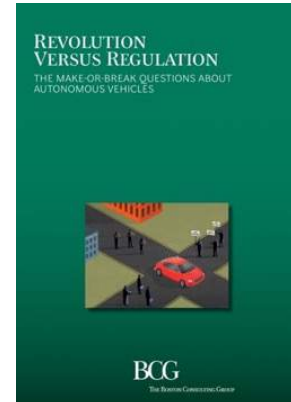
Less costly transportation, easier to use, more reliable trips downtown, could send citizens further out.

Revenues at risk

Loss of parking fees and tickets, fuel taxes, other vehicle-related fees and charges.

Funding to build necessary infrastructure

Public funds? Partnerships?



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key findings – government and policymakers

6. Sorting out the roles of policymakers

Ideas from Parsons Brinckerhoff:

FEDERAL ROLE		STATE AND LOCAL ROLE
Update, Establish and Enforce Policies and Regulations	Establish and Enforce Standards	Update, Establish and Enforce Policies and Plans
Safety	Manufacturing Vehicle	Mobility
Privacy/Data Sharing	Design Infrastructure	Infrastructure
Cyber Security	Data/Communications	Transit
		Financial

Source:

54



key findings – government and policymakers

7. Things local governments should start doing



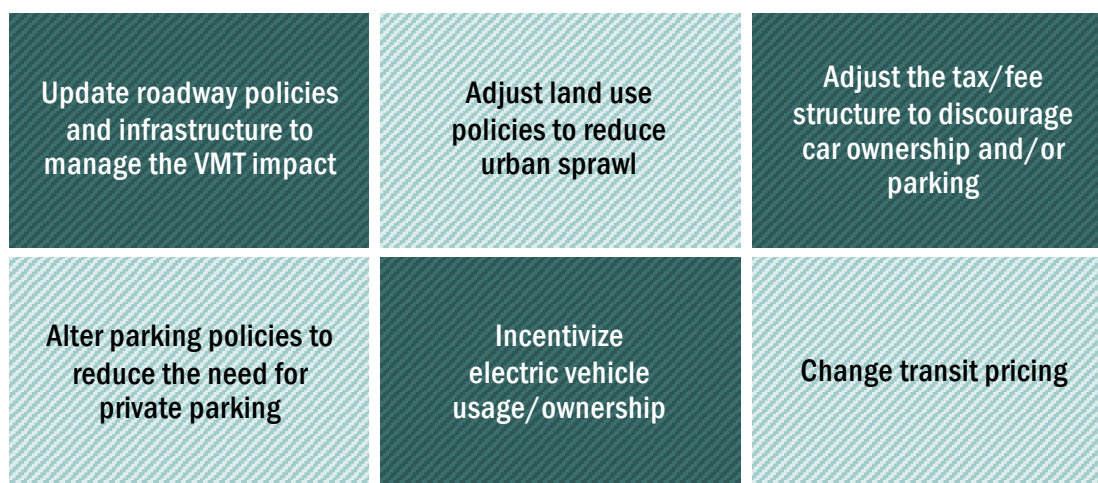
Source:

55



key findings – government and policymakers

8. Policy changes to start considering



Source:

56



key findings – government and policymakers

9. Short- and long-term tasks to consider

PLANNING

- Update travel demand model
- Evaluate road capacity needs
- Assess transit requirements
- Forecast financial implications

INFRASTRUCTURE MODIFICATIONS

- Update traffic signs and markings
- Reduce lane width
- Alter speed limits
- Adjust traffic signal locations & timing
- Eliminate/reduce parking and add more "drop-off/pick-up" locations
- Add electric vehicle charging infrastructure
- Develop new predictive models for pavement maintenance
- Certify roads for driverless and/or manual usage

MISCELLANEOUS

- Update enforcement function within the government
- Update incident management function within the government
- Incorporate driverless vehicle technology into government services
- Update government workforce to match needs

Source:

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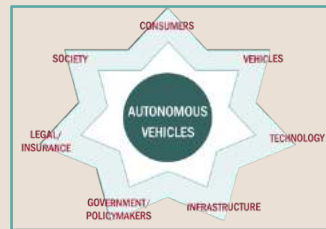


IMPLICATIONS for Government/ Policymakers

Government officials, transportation professionals, and policymakers need to **immediately start working on plans for the future of AVs** in Virginia.

The impact of AVs will be broad and wide and deserve careful thought and consideration. However, **regulation should follow innovation and marketplace acceptance**, not attempt to lead it.

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Legal/Insurance

Who is liable in accidents? Who pays what for coverage?

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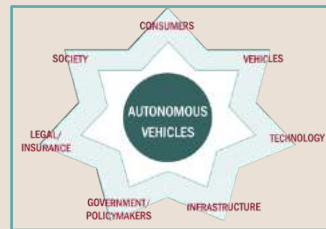


IMPLICATIONS for Legal/Insurance

While important, the legal and insurance related issues tied to AVs are **not critical to its development**.

Over the next decade these issues will be sorted out.

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Society

What industries are impacted by AVs? What happens to displaced workers like truck drivers, car mechanics in a fleet-owned autonomous world?

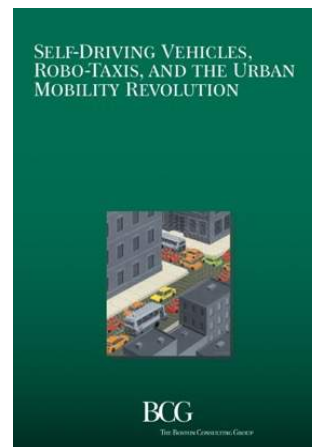
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key findings – society

1. This isn't just about cars, trucks, or roads

First, everyone in this knows it's about changing forever how people and goods move in our society, and improving life for all. But this “mobility revolution” won't simply save lives, it will change how we live, where we live, and for millions, even what we do for a living.



<http://www.bcg.com/expertise/industries/automotive/insights.aspx>

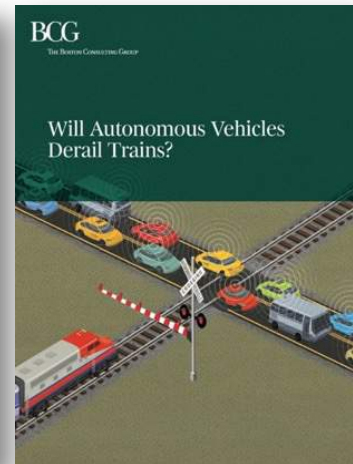
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key findings – society

2. The implications go far beyond roads

Articles and reports like these attempt to identify some of the ways AVs will change society.



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key findings – society

3. This will impact jobs, jobs, jobs

FOR EXAMPLE:

There are 3.5 million freight and delivery truck drivers in the United States.

There are 665,000 bus drivers.

In New York City alone, there are 90,000 registered taxi and livery drivers – not counting Uber and Lyft drivers.

If US car manufacturers miss out on this transition, or if we use vehicles more efficiently, there are 5.5 million people manufacturing and designing cars, and 1.65 million people working at dealerships.

ALL OF THESE JOBS ARE AT HIGH RISK.

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key findings – society

4. We've seen transitions like this before

There are no longer any buggy whip makers.

Blacksmiths are few and far between.

Travel agents are all but gone.

It's hard to find a bookstore anymore.

Video rental stores are forever gone.



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8. more than cars, trucks, and roads

How changing mobility changes everything

Urban planning/land use – road diets, fewer lanes, fewer highways

Cities get more dense as less space needed for cars, more available for walking, biking, living

Parking lots/garages disappear

No more car ownership as corporations have fleets of robo-taxis roaming the streets

Redesigned cars, all electric, less need for crash protection

No car dealers, mechanics, auto insurance, traffic tickets, gas stations

No more ambulance-chasing liability lawyers

No car loans

Traffic lights, signage less relevant as radar and mapping directs traffic flow

Power grid changes to provide charging

Less pollution, smog

Logistics and flow of goods will improve

No DUI, so restaurants/bars will sell more alcohol

Mobility for seniors, disabled will change where and how they live

Person-to-person movement of goods will become easier (no need to deliver in person)

Children will be able to move about unsupervised

Having a driver's license won't be relevant

From "50 Mind-blowing implications of self-driving cars (and trucks) <http://bit.ly/2dFxUej>

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key findings – society

5. Social equity will require attention

Issue: Lower Income Citizens

Available data suggests that lower income citizens may not have ready access to ride-sharing options like Uber, Lyft, and eventually AVs, that are hailed via mobile apps. They may not have smartphones, credit cards, or even bank accounts, all of which are needed to use most shared mobility options.

Could this be sorted out between now and 2040 so everyone can access these services?

Looking Ahead:

Interestingly, current usage of app-based tools available from transit agencies, at least in larger cities, indicates that across all income levels, even the lowest income levels, citizens are accessing the tools. (See the Shared Use Mobility Center's study [here](#).)

We believe tech solutions will emerge, like a "Mobility Card" that can "call" for transportation options without phone service and is prepaid and distributed to those in need.

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key findings – society

6. AVs could disrupt many parts of the economy

The implications are far-reaching and a bit mind-numbing. Here's a partial list from Deloitte:

ENERGY	Lower energy consumption from improved vehicle efficiency, electric vehicles. No gas stations?	PUBLIC SECTOR	Erosion of tax revenues related to property and fuel taxes, vehicle registrations, traffic citations.
FINANCE	Growth in fleet financing in place of auto loans and leasing.	RETAIL	Increase in sales due to increased mobility of underserved segments (seniors/disabled).
INSURANCE	Shifts from person liability to catastrophic systems-failure coverage.	TELECOM	Additional bandwidth requirements to meet increased demand for connectivity and reliability.
MEDIA	In-vehicle multimedia consumption, no more outdoor billboards.	TECHNOLOGY	Emergence of autonomous drive operating system players.
MEDICAL	Less need for emergency medical services, EMTs, and even ends ambulance chasing.	TRANSPORTATION	Substitution of demand for additional taxis, limos, and rental vehicles with shared fleets.

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key findings – society

7. AVs will be deployed in a range of ways

McKinsey issued a new report on the future of mobility that identifies three trajectories. They are suited to the type of metropolitan area based on density, infrastructure, wealth, congestion, etc.:

1. **Clean and Shared** – because of poor infrastructure, these areas may not see widespread use of AVs, but instead see cleaner transit in the form of AVs and shared mobility.
2. **Private Autonomy** – for areas with sprawling development and community patterns, like LA or Sao Paulo, where dedicated road space to AVs could emerge.
3. **Seamless Mobility** – for densely populated, high-income cities like Home Kong, Singapore, Chicago, and NYC. AVs and shared rides, with a strong public transit backbone, would dominate.



<http://bit.ly/2eyNfgg>

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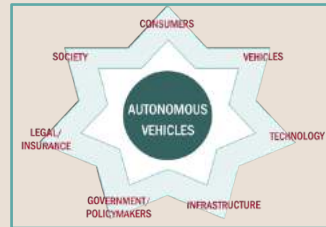


IMPLICATIONS for Society

AVs will be as significant and wide-ranging a disruption to society as the Internet, and will occur as quickly – over a 20-year time period.

Knowing such a monumental change is coming, the question we all need to ask is “**what should we be doing today?**”

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Summary of Findings

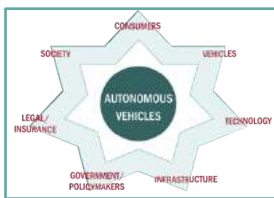
Plus, what are the **TAILWINDS** that could speed up adoption? What **HEADWINDS** will slow it?

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key findings – summary

AVs are the future, and sooner than we think.



1. Multiple **CONNECTED COMPONENTS** need to line up to make AVs a true marketplace reality.
2. **CONSUMERS** are interested, but supply will create demand. Not consumers.
3. **AVs** themselves are essentially here, now.
4. **Infallible TECHNOLOGY** is critical to success.
5. AVs will transform road **INFRASTRUCTURE**.
6. Government and **POLICYMAKERS** in Virginia need to react and plan now.
7. **LEGAL AND LIABILITY** issues won't slow AVs.
8. This isn't just about cars, trucks, or roads. All of **SOCIETY** and most of the economy will be impacted by AVs, and soon.

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tailwinds and headwinds

What factors could impact the adoption of AVs?

FAST LANE (Tailwinds)	SLOW LANE (Headwinds)
Aging Boomers who will want mobility options that enable them to live where they want.	OEMs who want to protect the car industry from being disintermediated.
Sharing Millennials who want to save money, and protect the environment.	Government regulators who want to control the speed of change and their transit investments.
Safety-minded Gen Z's who will want to save lives and reduce traffic accident injuries.	Impacted sectors of the economy: oil companies, auto dealers, related auto industries, truck drivers, injury lawyers, EMTs, and so forth.
Tech companies who are eager to sell their latest inventions.	Consumers who reject the "idea" of AVs before even experiencing them. And Luddites who resist change.

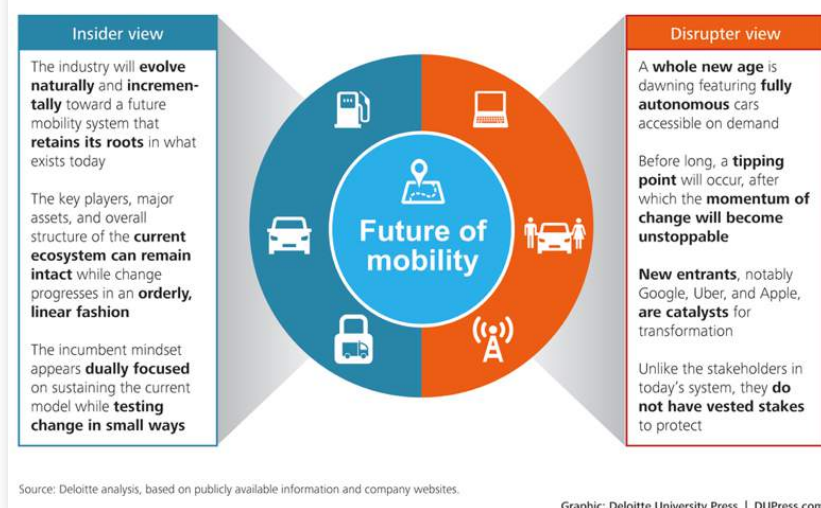
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tailwinds and headwinds

"Insider" vs. "Disruptor" view of mobility

Figure 3. "Insider" and "disrupter" views of the future of mobility

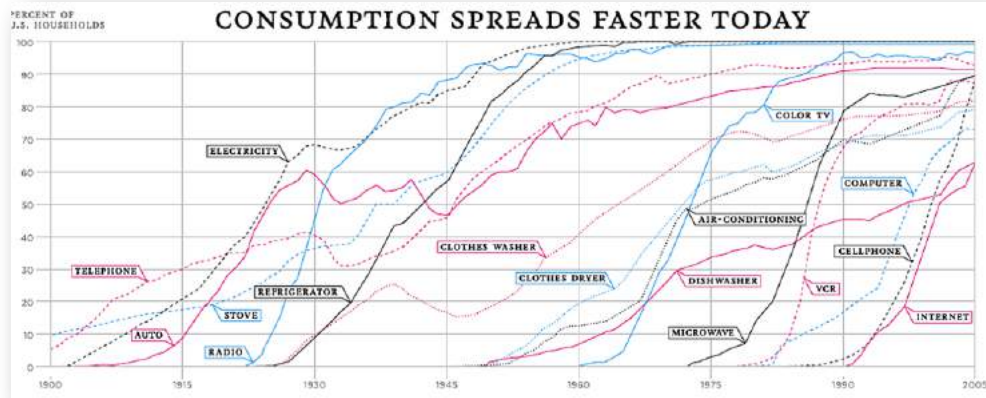


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tailwinds and headwinds

The rate of change is accelerating



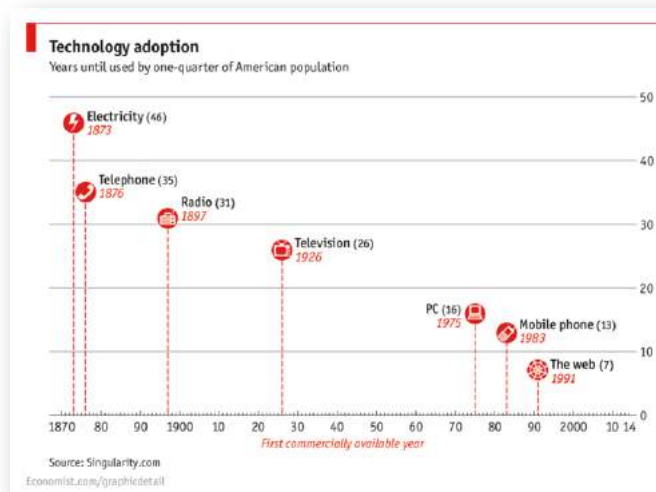
In the U.S., now most disruptive technologies only need 20 years to reach high levels of penetration in households.

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tailwinds and headwinds

The rate of change is accelerating (more)



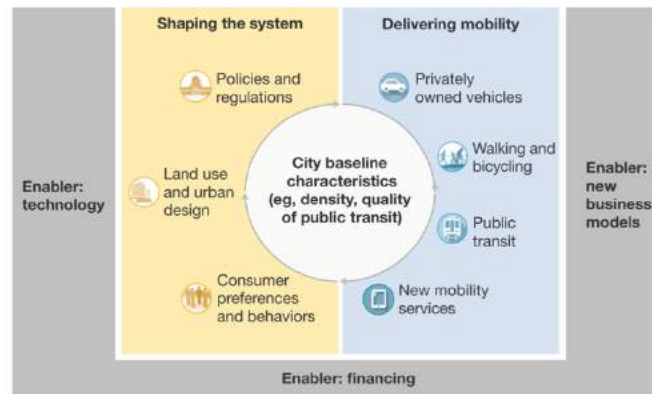
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tailwinds and headwinds

Factors impacting implementation speed

McKinsey has identified seven key factors that will impact how quickly mobility evolves in cities. The most critical factor is the basic composition of the city: density, quality of public transit, existing infrastructure, and overall wealth.



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What This Means for Scenario Planning

How VTrans2040 can use this to inform its work on developing the most likely long-term scenarios for the Commonwealth.

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